IV. *The Deſcription of an Apparatus for impregnating Water with fixed Air; and of the Manner of conducting that Proceſs.* By John Mervin Nooth, *M. D. F. R. S.*

Redde, Dec. 15, 1774.

THE poſſibility of impregnating water with fixed air was no ſooner aſcertained, by experiment, than various methods were contrived to effect the impregnation. The ingenious Dr. PRIESTLEY, however, is the only one that has publiſhed any deſcription of an apparatus, calculated intirely for this purpoſe. This apparatus was communicated to the public, with the view of promoting the diſcovery of the medical effects of fixed air united with water; and, in conſequence of this communication, ſome very ſucceſsful attempts have been made in the cure of diſeaſes. The experiments, however, have not been ſo numerous as one could have wiſhed; perhaps the difficulty in conducting the proceſs, in the manner propoſed, has been, in ſome meaſure, the reaſon why ſo few experiments, on this ſubject, have been made public. For although, in the hands of the doctor, the apparatus was ſufficiently convenient, it muſt be confeſſed, that the conduct of the proceſs required more addreſs than generally falls to the ſhare of thoſe that are unaccuſtomed to ſuch experiments. Independent too of the inconveniences attending the proceſs, there was another

objection to the apparatus, which, with moſt people, might have conſiderable weight. The bladder, which formed part of it, was thought to render the water offenſive; and when the ſolvent power of fixed air is conſidered, it will not appear improbable, that the water would be always more or leſs tainted by the bladder. In ſome trials which I made with Dr. PRIESTLEY's apparatus, it always happened, that the water acquired an urinous flavour; and this taſte in the water was, in general, ſo predominant that it could not be ſwallowed, without ſome degree of reluctance. The difficulty, therefore, in the conduct of the proceſs, and the offenſiveneſs of part of the apparatus, made ſome leſs exceptionable method of producing the impregnation deſirable. This I variouſly attempted, keeping convenience and cleanlineſs conſtantly in view; and I flatter myſelf, that I have at laſt contrived an apparatus that will perfectly anſwer the intended purpoſe. It is now twelve months ſince this contrivance has been in conſtant uſe; and hitherto there is no reaſon to wiſh for the leaſt alteration. Preſuming, therefore, on the poſſibility of its becoming, when known, extenſively uſeful, and convinced of the favourable reception which every attempt of this nature meets with from the Royal Society, I beg leave to communicate to them a deſcription of the apparatus that I have invented, and of the manner of conducting the proceſs.

DESCRIPTION

DESCRIPTION OF THE APPARATUS;

which is of glaſs, and conſiſts of three veſſels as (A, B, C), fig. 1. 2. 3. The glaſſes are accurately fitted to each other, and at the joints are impervious both to air and water. The glaſs (A) is deſigned for the effervеſcing ſubſtances. The veſſel (B) is to contain the water that is to be impregnated with air. In the lower part of the glaſs (B) is placed an ivory valve, ſurrounded with cork, as in fig. 4. The cork *(a)* is fitted to the bottom of the glaſs (B), and has through it an hole, to receive the part *(b)* of the ivory valve. On the broader part of this piece *(b)* is placed a moveable piece *(c)*. The ſurfaces of theſe pieces are ſo accurately ground, that, when applied to each other, no fluid whatever can paſs between them. The moveable part *(c)* is ſecured on the part *(b)* by the cover *(d)*, which is ſo conſtructed, as to allow the piece *(c)* ſome motion, and this cover has likewiſe holes to give paſſage to the air that ſhall raiſe the moveable piece *(c)*. The glaſs (C) ſerves two purpoſes; it confines the air on the ſurface of the water in (B), and at the ſame time prevents all danger of exploſion by allowing the water to give place to the aſcending air.

THE PROCESS.

As chalk and oil of vitriol are capable of producing the deſired effervеſcence, and are the moſt eligible on account of their cheapneſs, I ſhall, in deſcribing the proceſs, mention only theſe two ingredients. Variety of other ſubſtances

ſubſtances may, however, be employed for the ſame purpoſe; but none, perhaps, are ſo unexceptionable as thoſe I have named. In the other acids a proper degree of fixity is wanting, during the efferveſcence; the nitrous and marine have ſo much volatility that there is always a riſk of ſome of the acid fumes paſſing the valve, and thus rendering the water acid, which it was intended to impregnate only with fixed air. To begin the proceſs, it is neceſſary to fill the veſſel (A) up to the dotted lines, with diluted oil of vitriol. By confining the height of the ſurface of the efferveſcing mixture to the dotted lines in the glaſs (A), none of the acid will be driven through the valve, during the intumeſcence that attends the eſcape of the fixed air. The glaſs (B) is to be totally filled with water, and the veſſel (C) is to be put on it. Some powdered chalk is then to be thrown into the glaſs (A), and the veſſels are to be immediately placed as in fig. 5. except that the ſtopper belonging to (C) is to be left out. When the acid, in the lowermoſt veſſel, acts on the chalk, the extricated air paſſes the valve in the middle glaſs; and as the conſtruction of this valve allows the fixed air from the efferveſcing ſubſtances to paſs, but denies a paſſage to the water in a contrary direction, the ſeparated air aſcends to the upper part of the middle glaſs, and at the ſame time a portion of water, equal in bulk to the intruding air, paſſes up the bent tube into the uppermoſt veſſel. As the efferveſcence goes on, the fixed air continues to accumulate in the middle veſſel, and the uppermoſt one to be filled

filled with the water that has given place to the air. The quantity of chalk to be thrown into the acid at one time, muſt be determined by the capacity of the uppermoſt veſſel. Should more air be extricated than is ſufficient, in the conduct of the proceſs, to fill that veſſel, the water will run over the top of it, and will continue to run as long as any air aſcends in the middle veſſel, or till the ſurface of the water is below the extremity of the bent tube. Both theſe accidents are to be carefully avoided; as in one caſe, the whole would be wet and diſagreeable; and in the other, a quantity of fixed air would be unneceſſarily loſt. Half a dram of chalk will, in general, produce air enough to fill the uppermoſt veſſel with water; and it muſt be remembered, that the chalk employed to produce the effervescence, ſhould be finely powdered, as a ſelenitic cruſt will otherwiſe form around it, and thus prevent the action of the acid on the interior part. To keep the neck of the glaſs clean, through which the chalk is put, it will be neceſſary to include the chalk looſely in paper; and this circumſtance is by no means to be neglected, as the accurate junction of the glaſſes depends on it, and conſequently the whole of the proceſs. When the uppermoſt veſſel is filled with water, and there is, therefore, a conſiderable quantity of fixed air in the middle one, theſe two veſſels are to be ſeparated from the lowermoſt, and the air and water are to be agitated together, to promote their union. If, during the agitation, a ſtopper be put into the uppermoſt glaſs, the deſcent of the water in it will not ſhew the abſorption of the fixed

air

air by the water, as the external atmoſpherical air will enter below, at the valve, to fill the ſpace which the abſorbed fixed air would otherwiſe leave void. But, on the contrary, if the uppermoſt veſſel be open, during the agitation, the preſſure of the atmoſphere on the ſurface of the water in that veſſel, will force the water down into the middle one, as faſt as the abſorption of the fixed air below will allow it room. This latter method may be purſued, when a perſon wiſhes to know the quantity of fixed air that the water can abſorb; but in common uſe, it will be better to ſtop the uppermoſt veſſel, as the air and water may be then more forcibly agitated without inconvenience, and of courſe, the impregnation more expeditiouſly effected. During the efferveſcence, the uppermoſt glaſs is to remain open, and it is only to be ſtopped when the agitation is performed. It is not to be expected, that the impregnation will be conſiderable at firſt; it will indeed be neceſſary to repeat the proceſs, with the ſame water, four or five times, before it will be highly impregnated. After an agitation, therefore, when a ſtronger impregnation is wiſhed for, the uppermoſt veſſel is to be opened, and raiſed from the middle one, to allow the water to deſcend, that was before driven up. When the middle glaſs is again full, a freſh quantity of chalk is to be put into the lowermoſt veſſel, and the agitation to be repeated, as ſoon as the efferveſcence ceaſes. It is ſeldom neceſſary to repeat the proceſs more than four times, to produce a very ſtrong impregnation; but ſhould it be thought proper, to have the water as highly

ſaturated with fixed air as it admits of, nothing more than a repetition of the ſame proceſs is requiſite. In this account of the apparatus, I have purpoſely confined myſelf to the method of uniting fixed air with water; but it is to be obſerved, that many curious experiments may be made with it, both in chemiſtry and pharmacy. By its aſſiſtance, I have been enabled to imitate very perfectly, the common mineral waters, and to make aqueous ſolutions of ſubſtances that were before deemed inſoluble in water. Theſe circumſtances, however, I ſhall reſerve for a future paper, which I ſhall have the honour to preſent to the Society, as I have not yet been able to arrange the ſeveral facts, which this apparatus has made me acquainted with, in the manner I could wiſh.

POSTSCRIPT.

SINCE the foregoing paper was read, I have contrived a glaſs valve, which ſeems preferable in ſome reſpects to the ivory one therein deſcribed. The following is a deſcription of it. It conſiſts of three pieces, as in fig. 7. The ſuperior and inferior pieces are perforated, but the middle one is without perforation, having only its upper part convex and its under part plane. In fig. 8. is a perpendicular ſection of the three pieces compoſing the valve, at the diſtance at which they ought to be placed, with reſpect to each other, in the tabular part of the veſſel (B). This veſſel having the glaſs valve in it, and filled with water, is to be put on the glaſs (A),

containing ſubſtances in the act of efferveſcence. In that caſe, the extricated air will aſcend through the perforations in the ſuperior and inferior pieces, the middle one proving no obſtacle to the air, having ſufficient room to yield to the current of air ruſhing upwards; but when the air ceaſes to aſcend, and the preſſure of the water above takes place, the middle piece will prevent the water from deſcending, its plane ſurface being then applied to the plane ſurface of the piece below it. Thus, SIR, this glaſs valve will anſwer in every caſe where the ivory one can be employed; and for a variety of purpoſes it will undoubtedly prove preferable, particularly when corroſive ſubſtances are ſubjected to experiment.

Fig. 6.

Fig. 5.

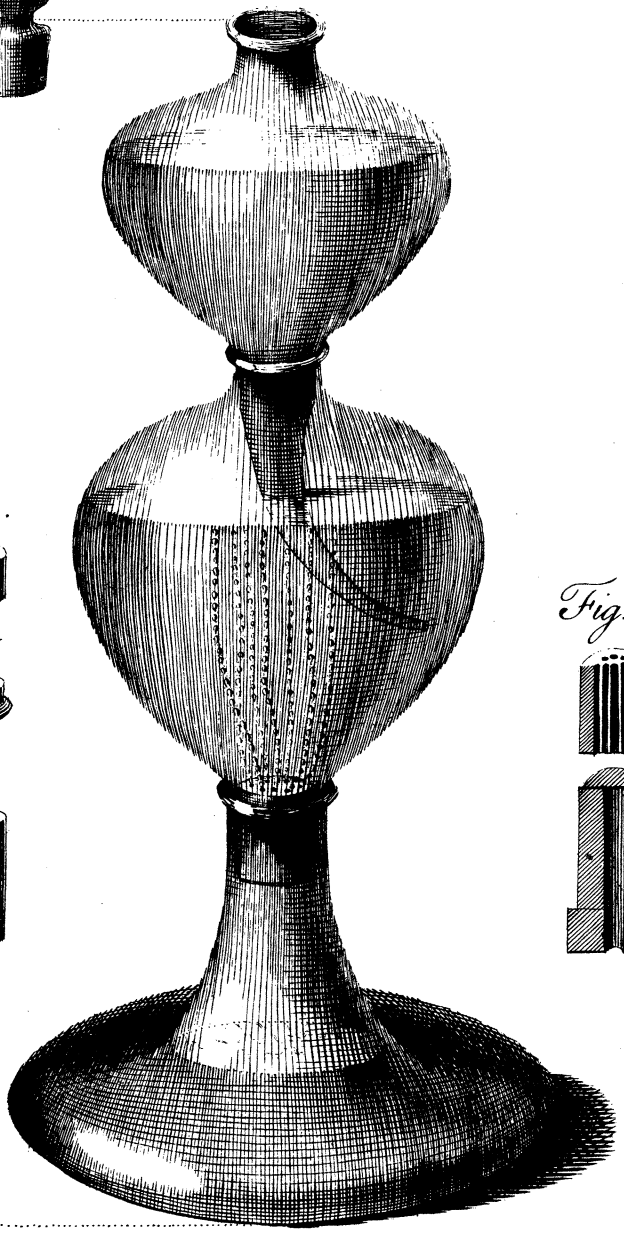

Fig. 3.

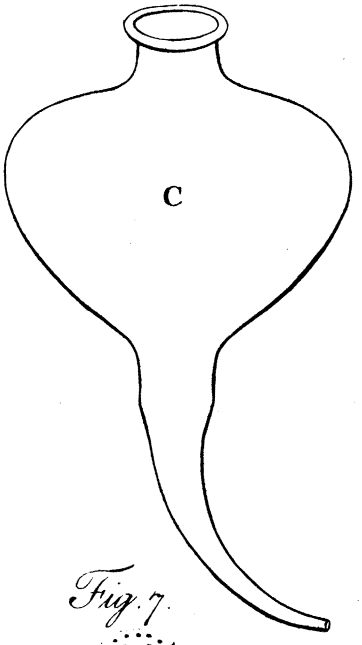

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Fig. 4.

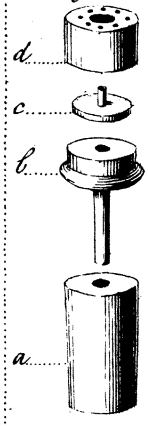

Fig. 8.

Fig. 7.

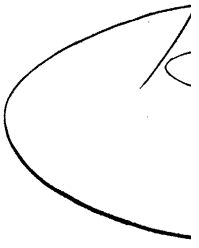

Fig. 2.

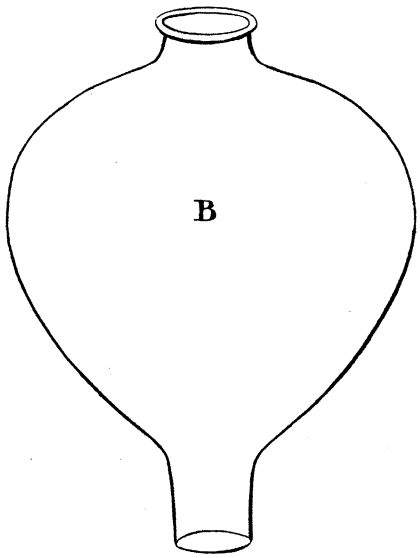

Fig. 1.

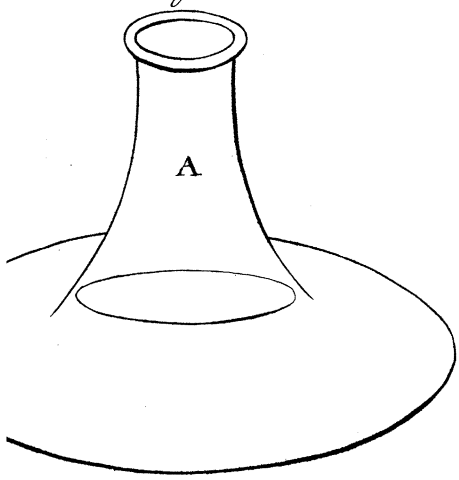

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Fig. 6.

Fig. 5.

Fig. 3.

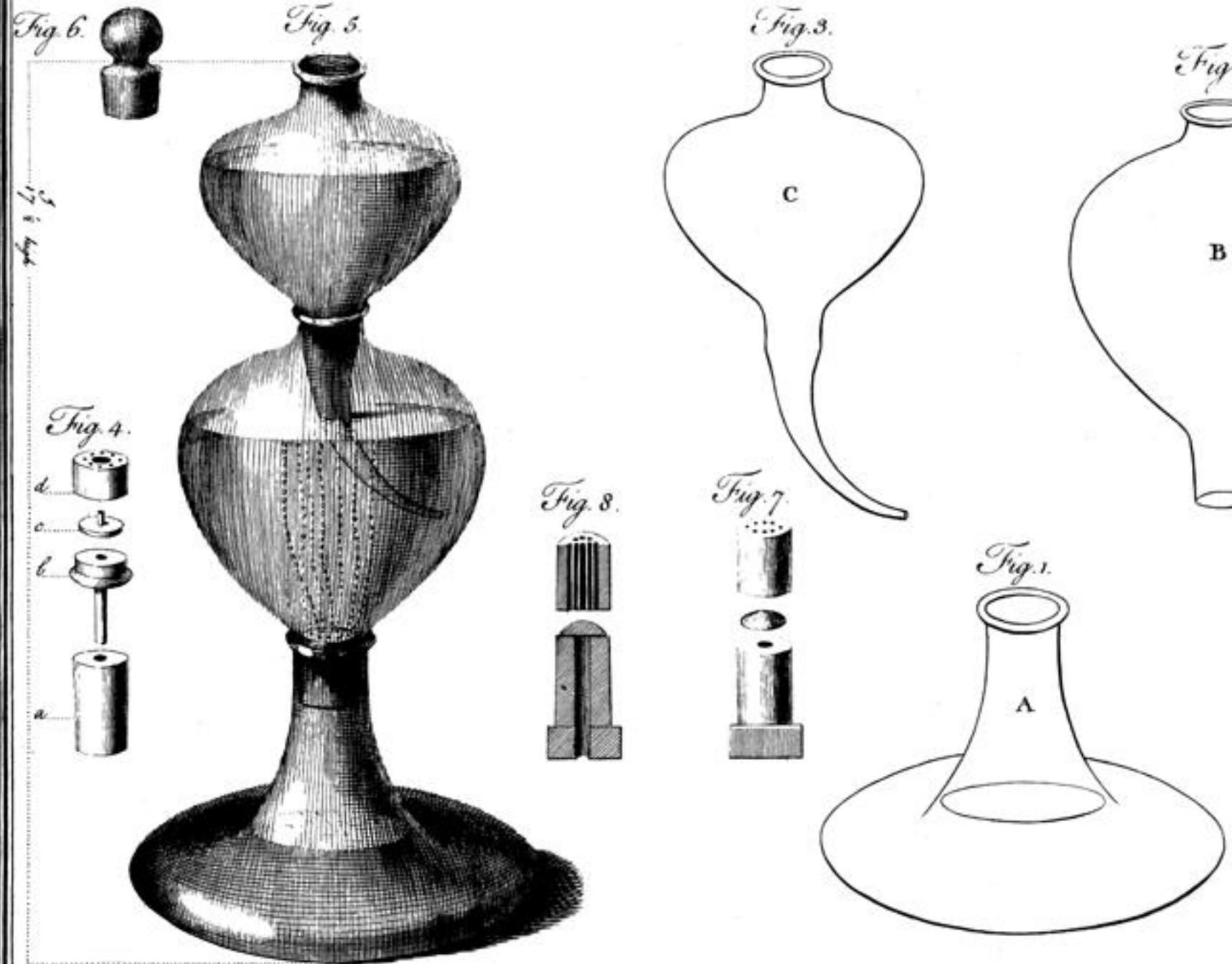
Fig. 2.

Fig. 4.

Fig. 8.

Fig. 7.

Fig. 1.



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